The first record of Bathynellacea from Thailand: a new genus and species of Parabathynellidae (Crustacea: Syncarida)

A.I. Camacho*a, S. Watiroyramb and A. Brancelj c

a Museo Nacional de Ciencias Naturales (CSIC), Dpto. Biodiversidad y Biología Evolutiva, C/ José Gutiérrez Abascal 2, 28006-Madrid, Spain; b Applied Taxonomic Research Centre, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand; c National Institute of Biology, Večna pot 111, 1000 Ljubljana, Slovenia

(Received 15 February 2011; final version received 4 August 2011; printed 6 October 2011)

A new genus and species of the family Parabathynellidae, Siambathynella laorsriae gen. nov. et sp. nov. is described from Thailand. The new genus displays an exclusive character: a distinctive male thoracopod VIII with a row of denticles on the basipod. The new species also displays a unique combination of morphological characters, including a seven-segmented antennule, seven-segmented antenna, sexual dimorphism on the antennule, exopod of thoracopod I one-segmented, exopod of thoracopod II–VII two-segmented, male thoracopod VIII lacking basipodal seta, female thoracopod VIII with two setae, lacking pleopods, sympod of the uropod with inhomonomous row of spines, and endopod of uropod with a spinous distal process and a large distal spine ornamented with rows of setules. This is the first record of Bathynellacea (family Parabathynellidae) in Thailand, extending the distributional range of this taxon in Asia.

Keywords: Siambathynella gen. nov; Parabathynellidae; Syncarida; groundwater; Thailand

Introduction

To date, the family Parabathynellidae includes 168 species belonging to 44 genera. Twelve genera (eight of them monotypic) and 34 species have been recorded in Asia, which means that 27% of the world’s known genera are Asiatic. As the Asian groundwater fauna is, as yet, poorly known, large unexplored areas still remain to be scrutinized from the biospeleological point of view.

Current taxonomy of the group is not completely satisfactory because some of the generic diagnoses are unclear, especially for genera described a long time ago (e.g. Allobathynella Morimoto and Miura, 1957, Eobathynella Birstein and Ljovuschkin, 1964), and significant overlap of characters occurs between genera (see Camacho, Trontelj et al. 2006). In the last 20 years several genera and species have been very well described (Serban 1994; Ranga Reddy 2002, 2004, 2006; Morimoto 2002; Ranga Reddy and Schminke 2005, 2009; Camacho 2005; Camacho, Trontelj et al. 2006; Ranga Reddy et al. 2008; Cho et al. 2008; Park and Cho 2008; Ranga Reddy and Totakura 2010), which facilitates the study of newly discovered taxa from Thailand.
The specimens of the new species are small, as are all members of the genera *Nipponbathynella* Schminke, 1973, *Batubathynella* Schminke, 1973 and *Habrobathynella* Schminke, 1973. These three genera have six segments on the antennule while *Nipponbathynella* and *Habrobathynella* have only two segments on the antennae. The new species has the exopods of thoracopods II–VII two-segmented as in *Nipponbathynella* and *Habrobathynella*. Among the Asian species only members of *Chilibathynella* Noodt, 1963 and *Atopobathynella* Schminke, 1973 have the male antennal organ as recorded in the new species from Thailand. The new taxon shares some generic characteristics with *Issykkulibathynella* Serban, 1994 and *Sabahbathynella* Schminke, 1988, (see Table 1). The Australian genera *Billibathynella* Cho, 2005 and *Octobathynella* Camacho and Hancock, 2010 are the only genera known to be characterized by a seven-segmented antenna – like the new species, *Allobathynella japonica* Morimoto and Miura, 1957 (see redescription in Park and Cho 2008) and *Allobathynella shinjongieei* Park and Cho, 2008; although members of *Billibathynella* have a seven-segmented antennule, they have a multi-segmented exopod on the thoracopods instead of the two-segmented condition of *Siambathynella laorsriae* gen nov. et sp. nov. The discovery of a new character for the family Parabathynellidae (basipod of male thoracopod VIII with denticles) leads us to propose the establishment of a new taxon, *Siambathynella* gen. nov., specially as the specific combination of other characters did not allow specimens of the new taxon to be included in any known genus. The new taxon displays a unique combination of character states, which justifies the establishment of a new genus and species.

**Materials and methods**

Specimens were collected from Tham Yai Nam Nao cave, Nam Nao National Park, Phetchabun, Thailand. *Siambathynella laorsriae* gen. nov. et sp. nov. was found in six samples: NN43 (5 November 2008) (six males, six females and two juveniles); NN19 (27 January 2008) (seven males, eight females and three juveniles); NN44 (5 November 2008) (one female); NN45 (5 November 2008) (one male and eight females); NN62 (9 February 2009) (five males, seven females and one juvenile); NN18 (27 January 2008) (one female).

Tham Yai Nam Nao cave is positioned in the Nam Nao National Park, about 200 km northwest of Khon Kaen (Thailand). It is about 10 km long, with horizontal galleries only. The entrance is under a high cliff, at an elevation of 684 m above sea level. The coordinates of the entrance are: 16°63′19.0″ N, 101°51′57.9″ E. Beyond the entrance is an approximately 800-m long horizontal gallery, accessible without any special equipment except a battery lamp. At some places in the inner part of the cave there are pools, filled occasionally by a swollen river and partly by dripping water. Specimens were collected from three shallow pools on clay deposits filled by percolating water from the ceiling. These pools are about 400 m from the entrance and along a tourist path. Water from those small water-bodies (volume of up to 3 l) was collected and filtered using special sampling equipment (Brancelj and Culver 2005). Water temperature in the pools was between 20 and 22°C, pH was 7.9–8.6, and conductivity was between 464 and 834 µS/cm. These pools are the type locality of the new species.
Table 1. Character variability within the various Asian genera of the Parabathynellidae family.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.I: N. sgt</td>
<td>6–8</td>
<td>7</td>
<td>6/7</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>male antennal organ</td>
<td>A</td>
<td>P/A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>P/A</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>A.II: N. sgt</td>
<td>5–7</td>
<td>5/6</td>
<td>5/6</td>
<td>5</td>
<td>5/6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Mx.I: N. claws (dist.endt)</td>
<td>5/6/7</td>
<td>5/6</td>
<td>4/6/7</td>
<td>5/6/7</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>5/6</td>
<td>7</td>
<td>5/6</td>
<td>6</td>
</tr>
<tr>
<td>Th I: epipod</td>
<td>A</td>
<td>P/A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>P/A</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Exp.: N. sgt</td>
<td>2–4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2/3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Th II: epipod</td>
<td>A</td>
<td>P/A</td>
<td>A</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Exp: N. sgt</td>
<td>2–4</td>
<td>1</td>
<td>2/3/4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>9</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Th III epipod</td>
<td>P</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Exp: N. sgt</td>
<td>2–5</td>
<td>1</td>
<td>2/3/4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Exp: N. sgt</td>
<td>2–7</td>
<td>1</td>
<td>2/3/4</td>
<td>2</td>
<td>4/3</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Th VIII male:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N. st. end</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1?</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Th VIII female (seg)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2 setae</td>
<td>1</td>
<td>—</td>
<td>A</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pleopod (seg)</td>
<td>1/2/A</td>
<td>1</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>Seta</td>
<td>A</td>
<td>A</td>
<td>Seta</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Urp: Symp: spines type spines</td>
<td>6/18</td>
<td>7/20</td>
<td>5/10</td>
<td>9/13</td>
<td>6/7</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>12</td>
<td>4/9</td>
<td>20</td>
<td>5/17</td>
<td>8–9</td>
</tr>
<tr>
<td>Hom./Inhom.</td>
<td>Exp: N. st.</td>
<td>3/6</td>
<td>3/4</td>
<td>2/4</td>
<td>2/3</td>
<td>4/5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Inhom.</td>
<td>End: N. spines</td>
<td>0/6</td>
<td>0/4</td>
<td>0/3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4/3</td>
<td>0</td>
</tr>
<tr>
<td>N. st</td>
<td>2/5</td>
<td>4</td>
<td>1/3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1/3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Furca: N. spines</td>
<td>3/6</td>
<td>6/14</td>
<td>3/5</td>
<td>6/9</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td>9/10</td>
<td>3/9</td>
<td>3</td>
</tr>
<tr>
<td>Anal operculum</td>
<td>Pr</td>
<td>Pr/N.Pr</td>
<td>Pr (S-M)</td>
<td>Pr (S)</td>
<td>Pr (S)</td>
<td>NPr</td>
<td>NPr</td>
<td>Pr (M)</td>
<td>Pr (M)</td>
<td>NPr</td>
<td>Pr (S)</td>
<td>NPr</td>
<td>NPr</td>
</tr>
<tr>
<td>(S-L)/A</td>
<td>Length max</td>
<td>3.3</td>
<td>2.8</td>
<td>2.3</td>
<td>1.5</td>
<td>1.5</td>
<td>2.0</td>
<td>2.1</td>
<td>1.7</td>
<td>1.9</td>
<td>1.1</td>
<td>3.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Habitat</td>
<td>W/C</td>
<td>C/R</td>
<td>W/R</td>
<td>W/R</td>
<td>C</td>
<td>Sp</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>R/W</td>
<td>C</td>
<td>R</td>
<td>C</td>
</tr>
</tbody>
</table>


Abbreviations: A, absent; A.I, antennule; A.II, antenna; A, absent; C, cave; dist.endt, distal endite; End., endopod; Exp., exopod; Hom., Homonomous; Inhom., Inhomonomous; max., maximum length in mm; L, large; M, medium-sized; N., number of; NPr, not pronounced; P, present; Pr, pronounced; R, river bank; S, small; seg. segmented; sgt, segment; st, setae; Symp, sympod; Th, thoracopod; Th.I, thoracopod 1; Th. VIII, thoracopod 8; Urp, uropod; W, well.
This cave is also the type locality for *Elaphoidella namnaoensis* Brancelj, Watiroyram and Sanoamuang, 2010, collected during the same sampling campaign, a co-inhabitant with the new species in some pools (Brancelj et al. 2010).

A complete dissection of all anatomical parts of all type series was made and kept as permanent preparations (special metal slides, glycerine–gelatine stained with methylene blue as mounting medium) and deposited in the Museo Nacional de Ciencias Naturales, Madrid (MNCN). Anatomical examinations were performed using an oil immersion lens (100 ×) on a Zeiss interference microscope. The descriptions are based on the type series.

The terminology has been adopted from Serban (1972) and Schminke (1973). Abbreviations used: A.I, antennule; A.II, antenna; Lb., labrum; Md, mandible; Mx.I, maxillule; Mx.II, maxilla; Th, thoracopod.

**Systematic account**

*Siambathynella* gen. nov.

*Generic diagnosis*

Antennule (A.I) seven-segmented, without aesthetascs on fifth segment and with subterminal aesthetascs on last segment, sexually dimorphic, with male antennal organ on second segment of antennule. Antenna (A.II) six-segmented, first, second and fifth segments without setae. Mandible (Md) with expanded distal claw on pars molaris. Maxilla (Mx.II) with four segments. Exopod of thoracopods II–VII each two-segmented, that of Th I one-segmented; basipod of thoracopods I–VII with one smooth seta; epipod of Th I absent. Male thoracopod (Th) VIII: almost square, with small endopod integrated into basipod and with two smooth long setae; exopod, large, rectangular, twice as long as wide, overhanging basipod with three strong teeth or spinules; inner lobe incorporated into basal region, rectangular, a little shorter than dentate lobe; reduced outer lobe, fused to basipod; basipod very large, rectangular, slightly recurved and with a row of small denticles on distal part, proximal side with two lobes, one of which recurved inwards and almost completely covering the exopod, without seta. Th VIII female: triangular, with two long setae. Pleopods absent. Ventrolateral seta of pleotelson long, barbed and placed adjacent to insertion of furca. Sympod of uropod with few spines (usually eight), the distal one twice as long as rest; endopod with a spinous projection on the distal outer corner and with one strong spine ornamented with rows of setules.

Type species: *Siambathynella laorsriae* gen. nov. et sp. nov.

*(Figures 1, 2)*

*Material examined*

 **Type locality.** “Tham Yai Nam Nao” (Nam Nao Cave), Nam Nao National Park, Phetchabun, Thailand, 18 males, 31 female and six juveniles were collected. The details of the description are based on all adult specimens. Holotype male 1.20 mm (MNCN
20.04/8567); allotype female 1.25 mm (MNCN 20.04/8568); the type series contains 47 additional specimens, paratypes (17 males and 30 females) (MNCN20.04/8569).

**Description**

**Body.** Male length between 0.99 mm and 1.31 mm; female, 1.03–1.83 mm. Body elongated, approximately 10 to 11 times as long as wide, segments slightly widening towards posterior margin; head about as long as broad. Pleotelson with one barbed ventrolateral seta at each side. All drawings are of the holotype (male) except for Th VIII female, and the second segment of the antennule, which are of the allotype.

**Antennule** (Figure 1A,C). Seven-segmented; first three segments similar in size and slightly longer than the other four; sexual dimorphism manifested in presence of antennal organ on inner distal margin of second segment (Figure 1A), well-developed and represented by long curved process, like elephant trunk almost reaching distal margin of third segment, and small half-ring-like structure. Female antennule allotype (Figure 1C) displaying only a small seta in homologous position to male antennal organ; inner flagellum almost trapezoidal; fourth and fifth segments of both sexes similar in size and half length of third segment; two distal segments similar in length, each about twice as long as fifth segment; latter without aesthetasc, sixth and seventh each with three aesthetasc placed subterminally on the last segment, each different in size; setation as in Figure 1(A).

**Antenna** (Figure 2B). Seven-segmented; attaining 60% length of A.I.; first three segments small, similar in size, about 50% length of fourth segment; latter about 125% length of fifth segment, which attains only three-fifths of length of each of the distal two segments; latter two of same length; distal segment with four setae, one of which plumose. Setal formula: 0/0/1+0/1+1/0+2/4(1).

**Labrum** (Figure 1D). Almost flat with eight main teeth, two central slightly different from rest, plus four lateral teeth at each side. Ventral surface ornamented with rows of fine spinules.

**Mandible** (Figure 1E,F). **Pars incisiva** with four teeth and well-developed triangular tooth of ventral edge; **pars molaris** with five claws, two strong distal claws slightly separated from the rest, both with subdistal small spines, and three small joined proximal claws with a large number of fine hairs; mandibular palp one-segmented, twice as long as wide, with distal seta not exceeding **pars incisiva** in length.

**Maxillule** (Figure 1G). Proximal endite with four long serrulate claws; distal endite with seven claws, all with denticles and fine long setules at the basis and three subterminal smooth setae on outer distal margin.

**Maxilla** (Figure 1H). Four-segmented, first two segments with an elongated endite, with two and three setae, respectively, one of setae on proximal endite plumose; third segment rectangular with two strong claws and six smooth setae; fourth segment reduced with one strong claw and four smooth setae. Setal formula 2, 3+1, 8, 5.

**Thoracopods I–VII** (Figure 2A–G). Well developed, gradually increasing in length from Th I to V, last two thoracopods similar; epipod absent on Th I, large on Th II–VII, each similar in length to corresponding basipod; basipod of Th I–VII with one smooth seta on inner distal corner. Exopod of Th I one-segmented, two-segmented in Th II–VII; exopod of Th II–V longer than first two segments of the
Figure 1. *Siambathynella laorsriae* gen. nov. sp. nov. (A,B,D,E,G–K) Male holotype: (A) antennule (dorsal view); (B) antenna (dorsal view); (C) second segment of antennule of female allotype; (D) labrum; (E) mandible; (F) pars incisiva of mandible, female allotype; (G) maxillule; (H) maxilla; (I) thoracopod VIII (complete caudal view); (J) thoracopod VIII (caudal view); (K) thoracopod VIII (frontal view); (L) thoracopod VIII female allotype (ventral view). Scale bar in mm. Abbreviations: D. Lb, dentate lobe; I. Lb, inner lobe; O. Lb, outer lobe; Bsp, basipod; Endp, endopod; Exp, exopod.
Figure 2. *Siambathynella laorsiae* gen. nov. sp. nov. (A–I) Male holotype: (A) thoracopod I; (B) thoracopod II; (C) thoracopod III; (D) thoracopod IV; (E) thoracopod V; (F) thoracopod VI; (G) thoracopod VII; (H) uropod (dorsolateral view); (I) pleotelson and furcal rami (dorsal view). Scale bar in mm.
corresponding endopod combined, that of Th VI and VII of about same length as latter endopodal segments; exopodal segments each with two barbed setae (with one group of strong ctenidia at base of inner setae). All endopods four-segmented; first segment of endopods of Th I–VII about half as long as next two segments, which are similar in length; fourth segment reduced, with two smooth, similar claws and one barbed seta; pair of smooth inner setae on first segment present only on Th I; inner setae on segments two and three always barbed on Th I to VII except on third segment of Th I, which are smooth; outer setae of third segment on Th I–VII barbed; outer distal setae on second segment of all Th plumose. Thoracopodal endopod setal formula: Th I, 2+0/2+1/1+1/3(1); Th II, 0+0/2+1/1+1/3(1); Th III to VII, 0+0/1+1/0+1/3(1).

**Thoracopod VIII male** (Figure 1I–K). Almost square; basal region of the penial complex with three lobes: inner lobe (I. Lb.), outer lobe (O. Lb.) and dentate lobe (D. Lb.); rectangular inner lobe integrated into basal region, a little shorter than dentate lobe; reduced outer lobe fused to basipod; small endopod (Endp.) integrated on basipod, with two long smooth setae; exopod large, rectangular twice as long as wide and overhanging basipod, with four strong teeth or spinules; basipod very large, rectangular, slightly recurved, caudally with a distal row of small denticles, on frontal side, with two lobes, one of which recurved inwards (crest-like protuberance) and almost completely covering the exopod; without seta.

**Thoracopod VIII female** (Figure 1L). Almost triangular, one-segmented with two long smooth setae.

**First pleopods**. Absent.

**Uropod** (Figure 2H). Sympod three times as long as wide, almost twice as long as endopod, with eight barbed spines along two-thirds of inner margin of segment, distalmost spine twice as long as others; endopod and exopod similar in size; distal outer corner of endopod produced into spinose process, with three rows of setules and one strong spine with two rows of setules, one plumose seta near and two small barbed terminal setae of different length; exopod with four barbed setae, two of them terminally, unequal in length.

**Pleotelson** (Figure 2I). With one small, barbed ventrolateral seta at each side close to insertion of furca. Anal operculum slightly concave.

**Furca** (Figure 2I). Almost square, with three barbed spines, outer two twice as long as innermost spine; two long equal dorsal plumose setae; lateral furcal organ “cork”-like.

**Etymology**
The generic name is dedicated to Siam, ancient name of Thailand. The species name “laorsriae” is derived from the given name of Prof. La-orsri Sanoamuang, supervisor of Santi Watiroyram, who studies microcrustaceans in epikarst zones of caves in Nam Nao National Park. (“laorsriae” is an adjective).

**Remarks and discussion**
To date, *Siambathynella laorsriae* gen. nov. et sp. nov. with *Allobathynella japonica* Morimoto and Miura, 1957 and *Allobathynella shinjongieei* Park and Cho, 2008 are the only species of Parabathynellidae known in Asia with a seven-segmented
A.II.; this feature is shared only with two other parabathynellid genera in the world, *Billibathynella* and *Octobathynella*, both from Australia. *Billibathynella* has seven segments on A.I as does the new genus, but *Octobathynella* has eight; both taxa have a multi-segmented (four to ten segments) exopod of thoracopods whereas the condition in the new genus is unisegmented on Th I and two-segmented on Th II–VII. These taxa differ also in male Th VIII and other morphological features (see Table 1 and Camacho and Hancock 2010 to compare). The new genus has no aesthetascs on A.I segment five as *Allobathynella japonica* and some members of the Australian genus *Brevisomabathynella* Cho et al. 2006, but all species of this genus have a multi-segmented (four to nine segments) exopod on Th II–VII. Table 1 shows the morphological differences between the Asian genera of Parabathynellidae. The new species is small, as are members of the genera *Nipponbathynella* Schminke, 1973, *Batubathynella* Schminke, 1973 and *Habrobathynella* Schminke, 1973; but these three genera have six-segmented A.I whereas *Nipponbathynella* and *Habrobathynella* have an A.II with only two segments. The new genus shares also with *Nipponbathynella* and *Habrobathynella* the two-segmented condition of the exopod of Th II–VII. Among the Asian genera only some species of *Chilibathynella* and *Atopobathynella* have a male antennal organ like the new species, but both genera have one-segmented exopods on Th II–VII, whereas these exopods in the new species are two-segmented. The inner setae on the endopod on Th I–VII are barbed in the new species, a feature shared only with the Chinese and Vietnamese genera. The only Asian genus with a one-segmented exopod on Th I and two segments on Th II–VII as *Siambathynella* nov. gen. is *Sabahbathynella* Schminke, 1973 but this is a large species, has a six-segmented A.I, it has no male antennal organ, the female Th VIII is reduced to a seta, the male Th VIII is very different, the sympod of the uropod is homonomous (inhomonomous in the new species) and there are four setae on the endopod of the uropod, whereas the new species has only three.

Unfortunately, the male Th VIII is not described with the same level of detail in all genera precluding the establishment of comparisons.

The new species shares some characteristics with *Issykkulibathynella* Serban, 1994, including the seven-segmented A.I, the four-segmented Mx II, the not pronounced anal operculum, the lack of pleopods, the endopod of the uropod with a spinous projection on the distal outer corner and armed with a large spine ornamented with rows of setules plus two apical barbed setae; the exopod of the uropod with four setae and the two-segmented exopod of Th II–VII. But *Issykkulibathynella* differs from the new genus in many other generic features (see Serban 1994): a six-segmented A.II, five teeth on pars incisiva of the Md, two distal claws on the distal endite of the Mx I devoid of denticles, 10 teeth on the labrum, Th II and Th III without epipod, exopod of Th I two-segmented, female Th VIII without setae, male Th VIII very large exopod and external lobe, and with well-developed endopod, distal spines of sympod of uropod shorter than the rest of spines, endopod of uropod with ctenidia on dorsal surface; other shared features are shown in Table 1, including two-segmented exopod of Th II–VII and four setae on exopod of uropod, but additional characters where they differ include: number of spines on furca, number of spines on sympod of uropod, number of setae of endopod of uropod, lack of male antennal organ, basipod of male Th VIII without distal frontal crest, etc.
The combination of characters of *Siambathynella* gen. nov. is unique within the Parabathynellidae as is the presence of denticles on basipod of male Th VIII. *Siambathynella* gen. nov. is unlike any of the 12 genera known to date in Asia, but has affinities with *Issykkulibathynella* (see Table 1) as we have seen, another unique Asian genus displaying rows of setules on the distal spine of the endopod of the uropod. Although there are some apparent morphological affinities between these Asian genera, the unique combination of the complete set of characters of the new taxon, warrants the establishment of a new species belonging to a new genus.

**Ecology**

Locations of the pools where specimens were collected left no doubt on their origin from the vadose/epikarstic zone of the cave. The vadose zone is part of the karst, only occasionally and locally filled with percolating water; it is also called the unsaturated zone. Epikarst is the topmost part of the vadose zone, usually from one to a few metres thick and partly filled with percolating water derived from rain (Brancelj and Culver 2005). Some aquatic animals live in such crevices, filled with percolating water and are occasionally washed out into the pools onto the floor of the cave galleries.

Epikarst has recently become recognized as a habitat that is rich in highly specialized aquatic cave-dwelling fauna with Copepoda (and Syncarida) as the dominant groups (Camacho, Valdecasas et al. 2006; Brancelj 2009; Brancelj et al. 2010). Characteristic of epikarstic fauna are: some morphological adaptations, recently recognized in Copepoda, and high endemism (Brancelj 2009).

Although two pools in Tham Yai Nam Nao cave could be occasionally filled by a swollen river (every few years), the third pool is high enough above the subterranean river not to be flooded at all. Associated copepod fauna from these pools are also characteristic of epikarstic species (Brancelj et al. 2010). To confirm their origin from the epikarst zone, filtering of dripping water is recommended using specially developed methods (Brancelj and Culver 2005). It is also recommended that minute morphological differences are studied between taxa living in different habitats as indicators of their adaptation to specific environments (i.e. hyporheic, phreatic, epikarst, groundwater).

**Distribution**

The current distribution of the 34 Asian species within the family Parabathynellidae covers: Japan, South Korea, Central Asia (Kirghizstan and Uzbekistan), Malaysia, Vietnam, India, southeast China and, including the new species described here, Thailand, where Bathynellacea has been found for the first time. These species belong to 13 genera, nine of them monospecific, whose distribution is very uneven (see Camacho 2005; Ranga Reddy and Schminke 2005; Camacho, Trontelj et al. 2006; Ranga Reddy 2006; Ranga Reddy and Totakura 2010). Recently, in India (Ranga Reddy 2002, 2004, 2006; Ranga Reddy and Schminke 2005, 2009; Ranga Reddy et al. 2008), species of genera known only from others continents, i.e. Africa (*Habrobathynella*) and Australia and South America (*Chilibathynella* and *Atopobathynella*) have been found. Also, in the last decade new genera have been found in Asian countries where no Syncarida were known, including Vietnam (Camacho 2005) and China (Camacho, Trontelj et al. 2006), and Japan and Korea have delivered new species of *Nipponbathynella* (Morimoto 2002; Cho et al. 2008) and *Allobathynella*.
(Park and Cho 2008). All of these findings are very interesting from a biogeographical point of view because they extend the distribution range of some genera. They are also interesting from a phylogenetic point of view, because the discovery of new characters and new character states can help to resolve relationships among genera and species.

There are still many unexplored areas in southern Asia that undoubtedly harbour many (new) species.

The distribution of the Asiatic species is as follows.

(1) *Allobathynella carinata* (Ueno, 1952). Type locality: Hachioji City, western suburbs of Tokyo, Japan.
(2) *Allobathynella kuma* (Ueno, 1956). Type locality: Hinagu, Kumamoto, west coast of Kyushu, Japan.
(6) *Allobathynella gigantea pluto* (Morimoto, 1963). Type locality: Shimohanda, Dainan-cho, Oita, Kyushu, Japan. Other localities: Miyazaki City and Tsuma, Saito City, Miyazaki Kyushu, Japan.
(8) *Allobathynella japonica* Morimoto and Miura, 1957. Type locality: Wadayama, Japan Sea, Hyogo, south of Honshu, Japan. Other localities: Taishi-machi and Aioi City, Hyogo, south of Honshu, Japan.
(9) *Allobathynella shinjongieei* Park & Cho, 2008. Type locality: Geochang, Kyungsangnamdo, South Korea.
(15) *Issykkulibathynella tianschanica* (Jankowskaja, 1964). Type locality: Issyk-kul lake, near Biological Station of the Academie of Sciences of Kirghiz, Tian-Chan North, Kirghizstan (former republic of USSR).


(19) *Batubathynella malaya* (Sars, 1929). Batu caves, near to Kuala Lumpur, Malaysia.

(20) *Sabahbathynella wongi* Schminke, 1988. Type locality: Sungai Masalog, between Keningau and Tenon, Sabah, Borneo, Malaysia.


(31) *Sinobathynella decamera* Camacho, Trontelj & Zagmajster, 2006. Type locality: Si Haizi Dong (Four Children’s Cave), some 300m south from Qiantian village, Changjiang County, outside the Bawangling National Nature Reserve, Hainan Island, China.


(33) *Atopobathynella operculata* Ranga Reddy, Drewes and Schminke, 2008. Type locality: Godavari River, Rajahmundry, southern India.

(34) *Siambathynella laorsriae* sp. nov. Type locality: Tham Yai Nam Nao cave, Nam Nao National Park, Phetchabun, Thailand.
Acknowledgements

We gratefully acknowledge C. Puch who helped us in various ways. The younger author (S.W.) would like to thank the Thailand Research Fund special programme for the Royal Golden Jubilee Ph.D. Programme No. 4.B.KK/49, and the Thai Commission on Higher Education (CHE-RES-RG Programme) for financial support. This work was supported by project grant CGL2010–15786 (Ministerio de Ciencia e Innovación, Spain).

References


